

Chapter 8 Contemplating POPs and the Future

Treaties are guided by past experiences, negotiated in the present, and look to a better future. For the Stockholm Convention, a fundamental consideration is what the future might hold in decades to come in the absence of action. As with the accumulation of POPs in the environment, the passage of time necessitates thinking beyond the present day. What will be future sources and levels of POPs emissions, and could the Stockholm Convention affect these emissions? This chapter informs these considerations by summarizing the results of existing demographic and economic futures forecasts. The models demonstrate that future POPs source regions will likely be different from current ones, and that very large regional growth rates in human populations and economic and industrial activity could drive POPs emissions in the absence of controls.

The futures modeling scenarios to be presented were developed and reviewed as part of the Intergovernmental Panel on Climate Change (IPCC) research program. Rather than estimate specific POPs emissions, the models focus on the growth in current economic activities in which POPs are used or emitted under current production and use patterns. The intent is to indicate the general pattern of economic growth and important sectoral components of these activities. Results are presented for the Special Report on Emission Scenarios (SRES) B2 scenario, one of the four basic classes of scenarios developed for the recent IPCC report (IPCC, 2000). The SRES B2 scenario was selected because it falls roughly in the center of future projections of population and economic activity, yet is relatively optimistic about the future of presently developing countries and does not contain major new policy initiatives. Most of the data presented come from the MiniCAM (Edmonds, 1985, 1996) version of the B2 scenario developed and submitted to the Special Report by the Global Change

Group (GCC) at Battelle Pacific Northwestern National Laboratories (PNNL) (IPCC, 2000; pp. 566-570), or, in some noted instances, from recent revisions based on model improvements. Results from the Second Generation Model (SGM), the GCC's larger and more detailed emissions model (Edmonds et al., 1995), were used for some of the detailed sectoral results. The SGM model run used for these results largely reproduces the aggregate population and economic activity patterns of the PNNL MiniCAM B2 model, acting as an internal validity check of the results expected in a "B2 future world."

The SRES B2 projection is commonly considered the "business as usual" scenario. Such a scenario assumes a continuation of past trends in population, technologies, and industrial output, with no major shifts in government policy. This forecast is the basis for all U.S. Administration energy and climate change analysis. For the forecasts included in this chapter, U.S. population and gross domestic product (GDP) trajectories have been modified from the SRES (IPCC, 2000) report to track the most recent Annual Energy Outlook forecast (U.S. DOE, 2000). Results are modeled to the year 2050. It is important to recognize that population, GDP, and the nature and structure of economic activity can be quite different from the values given here. Using B2 as a representative case should not be interpreted to mean that this is the most likely situation. It is used because it provides a good qualitative sense of how activities leading to POPs emissions might grow in the absence of additional control strategies.

The results of the B2 model runs are presented under two basic categories: general growth and sector-specific results. The general categories are factors such as population, economic, and industrial growth that act as potential pollution drivers.

These general drivers are not necessarily linearly associated with environmental pollution, as economic growth and prosperity have also led to enhanced pollution awareness and the means to combat it. The sector-specific forecasts have been selected for their potential relevance to one or more of the listed POPs. For instance, if the use of chlordane and other POPs termiticides is continued, the emission levels would likely relate to such factors as housing starts. Current byproduct POPs emissions come from municipal and hospital waste incineration, open burning of wastes, chlorine bleaching of pulp and paper, and iron and steel sintering, among others. In the absence of additional control technologies, future byproduct emissions from these sources could reasonably be expected to increase, with the sectoral projections acting as a proxy for these emission increases.

General Worldwide Growth Projections

Population Growth

Human population growth is central to all pollution scenarios. All of the POPs were either developed and produced to satisfy contemporary human needs, or are the byproducts of human activities. Figures 8-1 and 8-2 provide forecasts of human population growth rates and projected levels by region. The population forecast used here closely mirrors the most recent United Nations median forecast (Population Division; United Nations, 2000) that the total world population will reach 9.3 billion by 2050. As evident in Figure 8-1, the pro-

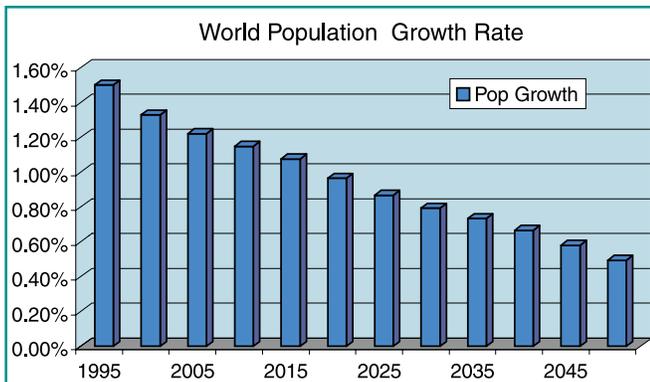


Figure 8-1.

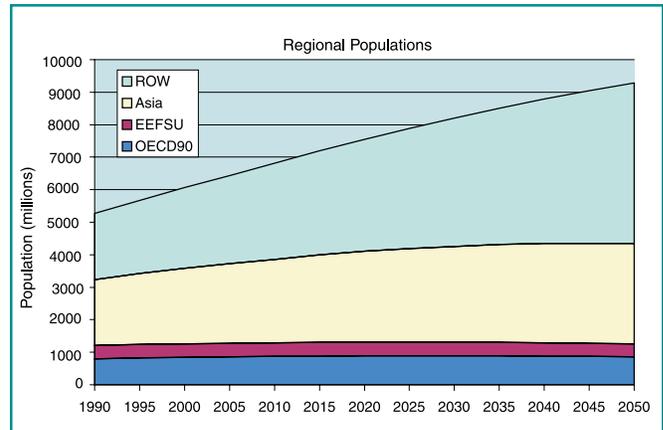


Figure 8-2. ROW, rest of world; EEFSU, Eastern Europe Former Soviet Union; OECD, Organization for Economic Cooperation and Development.

jected global population growth rate is decelerating, although it remains uncertain how long this trend will continue. The global average rate conceals large variations across regions, with the Rest of the World (ROW) region continuing to grow rapidly, whereas the population is declining in all Organization for Economic Cooperation and Development (OECD) countries except the United States.

The projection of total world population (Figure 8-2) demonstrates that population increases will likely be concentrated in three areas, the largest being the rest of the world category, comprised principally of Latin America and Africa (LAA) in this graph. China and India are the other two large contributors, with the Chinese population estimated to have peaked by 2030 and in a slow decline by 2050. The Indian population, in contrast, continues to grow, although not as rapidly as the rest of the world. The current group of developed countries will constitute only about 10% of the world population by 2050. The global population will be much older on average than it is today, with the average age increasing from 26 to 36 years (United Nations, 2000)

Economic Activity

In contrast to the ~50% growth in population, global economic activity is projected to increase fourfold, from US\$22 trillion in 1990 to \$88 trillion in 2050 (in 1990 U.S. dollar equivalents). Average per capita income will more than double.

The overall pattern of economic activity shows a large shift from its current focus in North America and Europe to Asia, Africa, and Latin America (Figure 8-3). Half the growth in economic output will occur in these areas, with their share of economic activity projected to rise from 16% to 41% over the half-century. The growth in ROW GDP is especially large, reflecting a combination of rapid population growth and increase in per capita income from just over \$1,000 per capita to about \$4,500 per capita. Because these areas currently have quite low per capita income levels, it is anticipated that much of this growth will go to the provision of essential physical commodities, such as infrastructure and appliances. In contrast, the economic growth in the currently developed economies will likely be focused in areas such as services, which are less intensive users of such inputs as energy and chemicals. The likelihood exists, therefore, that much of the growth in potential POPs-producing activities could occur in developing countries.

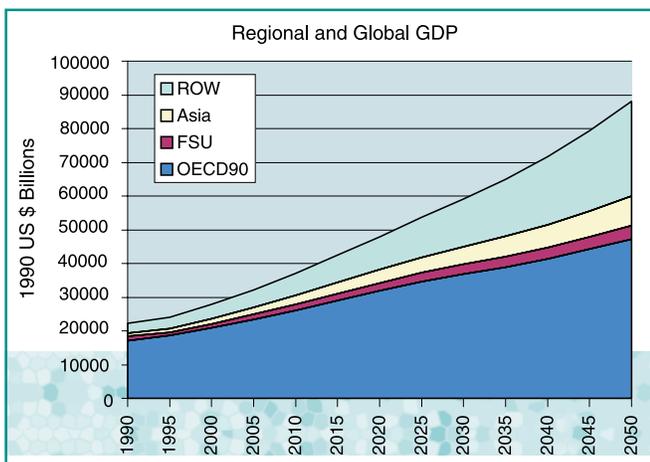


Figure 8-3. ROW, rest of world; EEFSU, Eastern Europe Former Soviet Union; OECD, Organization for Economic Cooperation and Development.

Agricultural Output

The pattern of agricultural production shows a similar, although less pronounced, shift from developed to developing countries (Figure 8-4). The models predict a nearly 2½-fold increase in agricultural output worldwide, with the OECD share falling from about two-thirds to just over one-half. Data from similar scenarios in the SRES database

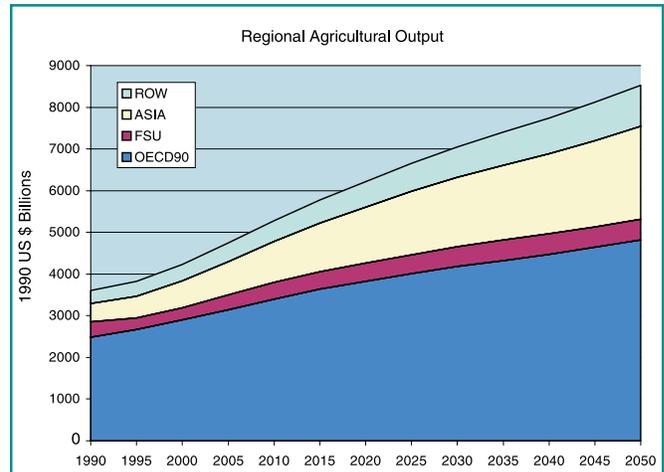


Figure 8-4. ROW, rest of world; EEFSU, Eastern Europe Former Soviet Union; OECD, Organization for Economic Cooperation and Development.

(CIESIN, 2001) suggest that this growth in output will occur with only minimal growth in land area allocated to agricultural production, implying a significant increase in intensity of production and a corresponding increase in agricultural chemical use.

Energy Consumption

Although not a major contributor of the 12 initial Stockholm Convention POPs, total energy consumption and associated gaseous and particulate emissions serve as an additional proxy for economic development. Total electricity consumption is predicted to grow by more than a factor of six, rising from 35 EJ (exa-, 10^{18} joules) in 1990 to 233 EJ in 2050 (Figure 8-5). The proportion of electricity consumed outside OECD countries also rises

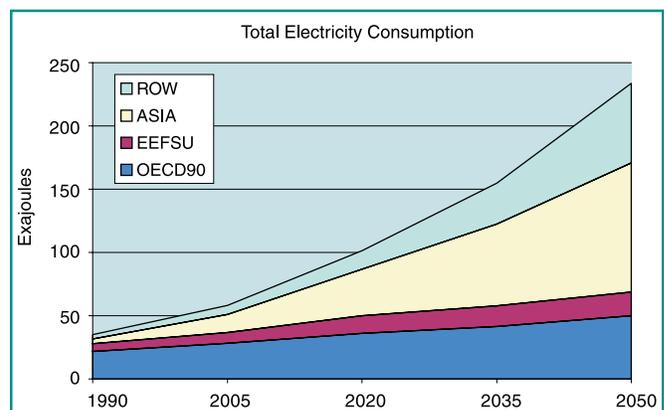


Figure 8-5. ROW, rest of world; EEFSU, Eastern Europe Former Soviet Union; OECD, Organization for Economic Cooperation and Development.

rapidly, from 38% in 1990 to 79% in 2050. Although the fraction of electricity generated by fossil fuel inputs declines slightly during the 1990-2050 period (60% to 52%), the strong growth in electricity demand is predicted to increase global CO₂ emissions from 5.6 billion tonnes to 12.1 billion tonnes (Figure 8-6), with the developing-country proportion rising from 59% to 77%.

Sulfur emissions provide an important counterexample to the general upward trend in emissions and economic activity. Despite the rapid growth in electricity use and coal-fired plants, sulfur emissions are expected to decline sharply over the next half-century (Figure 8-7). This decline results from the development and application of control

technologies, a situation somewhat analogous to the POPs byproduct controls under the Stockholm Convention.

Sector-Specific Growth Projections

The preceding demographic and economic factors act as general—but nonspecific—drivers of pollution and POPs levels. In some instances, specific sector models are available that more closely link economic activity with one or more POPs. Two such examples are summarized below: housing starts and termiticide use; and municipal waste generation and selected industrial production categories and potential byproduct emissions. Although the links between these sectoral projections and potential POPs releases are indicated, no attempt is made to perform further modeling beyond the existing projections.

Housing Starts and Termite Control

Of the POPs pesticides, chlordane (and heptachlor and mirex) continues to be used for household termite control in both wood and brick construction in a number of developing countries. Chlordane is relatively cheap and provides long-lasting termite control in the soil beneath and around houses, but ultimately may be released into the environment and transported far from its site of application. Alternative non-POP pesticides, physical barriers, and construction techniques are available for termite control, but the sheer persistence and toxicity of chlordane is still considered by some to be a substantial asset in the struggle against termites, especially in the tropics. On cessation of production in the United States, China commenced chlordane manufacture and has requested an exemption for production and use as a termiticide in buildings and dams. Several other countries have requested use exemptions for chlordane as a termiticide (UNEP, 2001).

Sector-specific projections indicate that growth in households worldwide will be substantial, because of an overall growth in population and as that population ages and becomes more urban. The estimates provided here reflect only the aging and population growth components, but not the im-

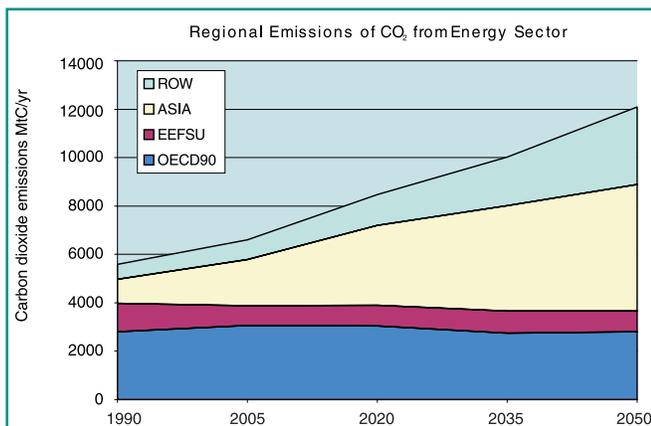


Figure 8-6. ROW, rest of world; EEFSU, Eastern Europe Former Soviet Union; OECD, Organization for Economic Cooperation and Development.

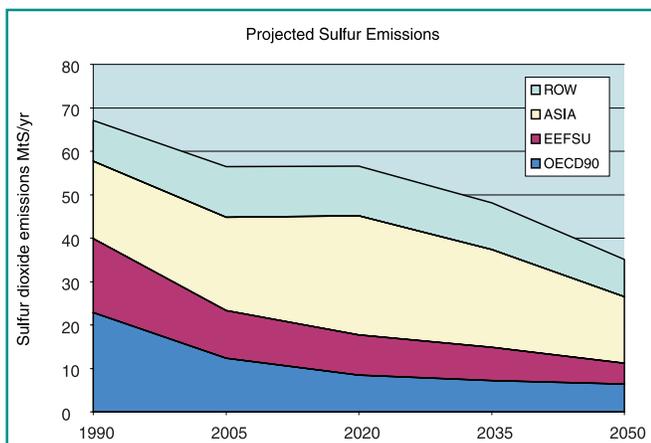


Figure 8-7. ROW, rest of world; EEFSU, Eastern Europe Former Soviet Union; OECD, Organization for Economic Cooperation and Development.

pacts of urbanization. They are based on age-specific head of household rates from MacKellar et al. (1995) (Figure 8-8). Total annual new household formation is projected to reach nearly 35 million by 2015 and then slowly decline to below 25 million annually by 2050. Almost all of this new household formation will occur in the developing world.

Municipal Waste Generation and POPs Byproducts

Polychlorinated dioxins and furans are principally formed and released from the incineration of municipal and hospital wastes, resulting from a combination of poor burn parameters, organic matter, chlorine, and metal catalysts. Although data quality issues exist for projections of solid waste generation, enough is known to indicate that the solid waste stream will grow rapidly over the next half-century. A recent World Bank report suggests two drivers for this growth: an increase in urban populations and an increase in the income of urban dwellers. Urban dwellers generate several times more waste than do rural dwellers (World Bank, 1999) (Table 8-1). Wealthy urban dwellers generate about 2.5 times more waste per capita than do poor urban dwellers. Over just 25 years, Asia is predicted to move from about 30% to more than 50% urban dwellers. Forecasts suggest that the rest of the developing world will follow a similar pattern. The World Bank study estimates an overall growth in municipal solid waste of 2.4-fold by 2025, to a total of two-thirds of a billion tons annually in Asia alone. The waste stream is forecast to become more combustibile and organic in composition, making incineration an increasingly attractive option, while landfills become more scarce.

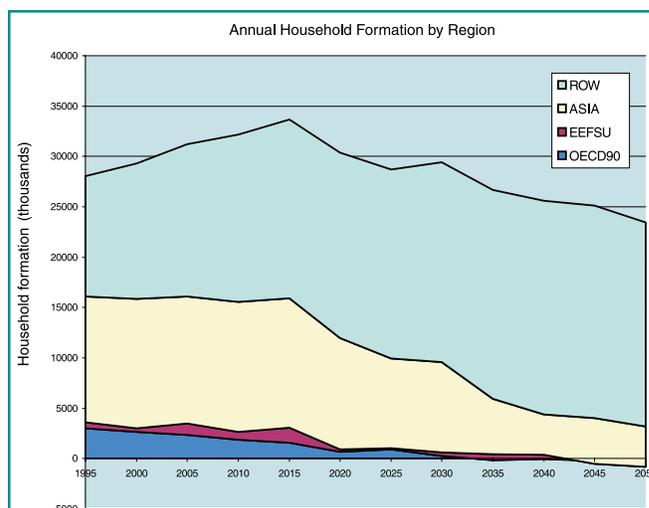


Figure 8-8. ROW, rest of world; EEFSU, Eastern Europe Former Soviet Union; OECD, Organization for Economic Cooperation and Development.

Industrial Processes and POPs Byproducts

Other sources of polychlorinated dioxin and furan byproducts listed in the Stockholm Convention include elemental chlorine bleaching of pulp and paper, iron ore sintering, and secondary metals production, such as poorly performed recycling through incineration of copper and other metal-containing items. Projected increases related to these activities are shown for a subsection of regions where data are available. The model results for wood production, relevant to the extent they can be considered a proxy for pulp and paper manufacture, demonstrate an approximate fourfold increase over 50 years, reasonably uniform across all regions (Figure 8-9).

Total steel production, a proxy for iron ore sintering, is projected to increase threefold by 2050 in the same five regions (Figure 8-10). China is pro-

Table 8-1. Current and future municipal solid waste (MSW) generation per capita

Region	1990			2025		
	GNP/Capita	% Urban	MSW/Capita	GNP/Capita	% Urban	MSW/Capita
Low-income Asia	490	27.8	0.64 kg	1,050	48.8	0.77 kg
Middle-income Asia	1,410	37.6	0.73 kg	3,390	61.1	1.17 kg
High-income Asia	30,990	79.5	1.64 kg	41,140	88.2	2.17 kg

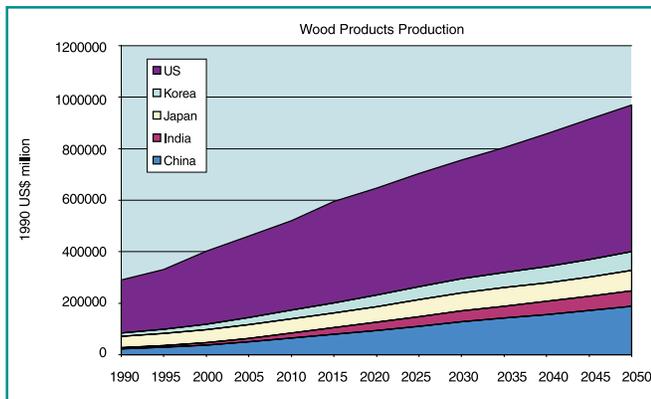


Figure 8-9.

jected to be the largest steel producer by the end of this period, with Japan and the United States remaining significant producers. Nonferrous metals are a much smaller part of production, and model results are available for only four regions. Absent data for China, the production picture for the four other regions remains dominated by the United States and Japan, with somewhat slower growth than for steel (graph not shown).

It bears noting that other POPs also have continuing connections to demographic and economic drivers in the absence of additional controls. DDT use continues for malaria vector control in the tropics, where projected increases in human populations are accompanied by a possible expansion of the range of the vector. Requests have been made under the Stockholm Convention for limited continued use of the pesticides mirex, heptachlor,

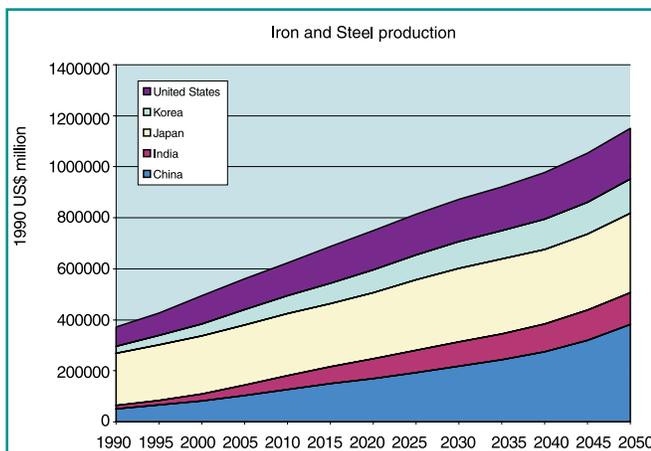


Figure 8-10.

aldrin, and dieldrin, principally for termite, ant, and locust control. Hexachlorobenzene production continues as an industrial intermediate and byproduct of chemical manufacture and incineration, and PCBs remain worldwide awaiting equipment retirement and destruction. Illegal agricultural use of a number of POPs also continues, and the potential exists for future POPs development for agricultural or industrial purposes in the absence of an implemented Stockholm Convention.

Summary

There will be large increases in the scale of world-wide economic activity over the next half-century, with overall economic activity predicted to increase about fourfold. Individual economic and end-use activities that either use or emit POPs can increase by more or less than this overall growth rate, depending on the specifics of the activity and its growth. Except for activities directly linked to population increases, such as new households or populations in mosquito-prone areas, none of the sectors is expected to grow by less than a factor of two, some growing by as much as sixfold. The Special Report on Emission Scenarios (IPCC, 2000) considers many scenarios other than those presented here, some with much higher levels of per capita incomes and lower populations, others with lower levels of economic well-being and higher populations. Yet all of these projections share a future of much higher total economic activity, and hence of potential uses and emissions of POPs in the absence of active control policies.

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